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Cylindrical vector modes in tapered optical fibers for atom nanotraps FREDRIK K. FATEMI, Naval Research Laboratory, JONATHAN E. HOFFMAN, Joint Quantum Institute, Dept. of Physics, UMD and NIST, College Park, MD 20742, SYLVAIN RAVETS, Laboratoire Charles Fabry, Institut dOptique, CNRS Univ. Paris-Sud, France, GUY BEADIE, Naval Research Laboratory, LUIS A. OROZCO, STEVEN L. ROLSTON, Joint Quantum Institute, Dept. of Physics, UMD and NIST, College Park, MD 20742 — Atoms confined to evanescent-field traps or lattices near tapered optical fibers are strongly coupled to photons propagating through the fiber. This strong coupling is ideal for quantum technologies and sensors. Previously, light propagation and strong atom-photon interactions have been demonstrated in fibers with submicron diameters, small enough to admit only the HE_{11} mode. Higher order cylindrical vector modes, which have azimuthally-varying polarization profiles, open another set of trapping geometries in fibers with diameters slightly above the HE_{11} cutoff value. In this work, we discuss propagation experiments in tapered fibers that allow the first excited family of modes. We have observed stable transmission of the TE_{01}, TM_{01}, and HE_{21} modes in 1.2-micron-diameter fiber, currently with 25% throughput. Transmitted power and beam profiles monitored during the drawing process show interesting power exchange between core and cladding modes, and by adjusting the drawing parameters we have experimentally probed the propagation behavior. Work supported by ONR, ARO, the Fulbright Foundation and the NSF through the PFC at JQI.

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